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ABSTRACT

A project undertaken at the University of Minnesota evaluated two microcomputer teletraining systems (audiographic conferencing) to determine the effectiveness of this technology for point-to-point and multipoint distance education. System design requirements included broadcast keystrokes, error checking, master-slave linkages, simultaneous voice and data transfer over one telephone line, simultaneous file transfer, and feedback utility. Four pilot tests were conducted with systems by two vendors (Tori and Optel). System components at each location included a modem, a standard telephone line, a device for amplifying voices, and appropriate software. A commercial teleconferencing bridge was used to facilitate linking the instructor with two or more locations. Results indicated that microcomputer teletraining can greatly reduce costs without sacrificing effectiveness. To pay back the initial investment, this technology is recommended where long-term training requirements are conducted on a frequent basis to multiple remote sites. Recommendations for using the technology and for further research are listed. Tables provide background data on the pilot tests and cost comparisons of teletraining and instructor travel. Twelve references are listed. (Author/MES)

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TELECOMMUNICATIONS DEVELOPMENT CENTER

TDC

TDC Research Report No. 1

January 1989

Developing Telecommunication Linkages for Microcomputer-Aided Instruction

Charles R. Blinn, Jan A. Flack, and Peter C. Bates

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TDC Research Report

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A B O U T T H E T E C H N O L O G Y

Audiographic Conferencing

Carol Scipioni, Informational Specialist, TDC

Overview. Audiographic conferencing is a microcomputer-based integrated system consisting of conferencing software and special modem, and a graphics tablet can be applied. Simultaneous two-way voice and still visual transmission over a single telephone line can be used to connect an instructor with students at one or more remote sites. A telephone bridge such as Alliance or Darome must be used if multiple training sites are connected at the same time. Up to 59 sites may be connected simultaneously.

A video camera, VCR, or videodisc player may also be used to input still-frame color video images. Other peripherals such as a facsimile machine or video tape player can be used to support an audiographics session. A second telephone line is usually required for a facsimile machine. Instructor and students can interact in real time via audio, computer keyboard or graphics tablet (electronic blackboard).

Audience and Applications. This technology may be used as an alternative to classroom-style, face-to-face instruction for a variety of audiences and applications. Audiographics can be used in lieu of slides and overheads normally used in a classroom setting. The implementation of a teletraining system necessitates that an organization examine its current training needs and procedures, and then determine how to incorporate this new approach for increasing the efficiency and cost-effectiveness of training and professional development programs (Chute 1984). Sound course design with clearly designed educational objectives, where audiographics can help meet those objectives, provides for optimum learning experiences.

An on-site coordinator who is familiar with the technology is an important asset to the administration of a training program. The on-site coordinator may be responsible for setting up and testing the equipment, demonstrating the use of the equipment to the participants, being available to handle technical problems, verifying that advanced visual materials are available, distributing handouts, administering tests, and returning materials to the speaker (Maher 1986).

These approaches to instruction should be considered when designing an audiographics session: a variety of instructional strategies, short learning segments, lots of student interaction, directed-open questioning, personalizing, good media mix, and frequent breaks. This technology can be particularly effective and cost-efficient where there are limited instructors, when information is new and/or quick changing, and where there is geographical dispersion of students and/or instructors (AT&T 1985). Audiographics is not particularly suitable for teaching psychomotor skills, such as learning how to perform a medical procedure.

Hardware and Software. A personal computer with a minimum of 256 K RAM is required. A hard disk and color monitor are recommended but not necessary. A color graphics adapter and an RS-232 communications port are also needed. The graphics tablet, which is used to create or annotate text and graphics, requires an expansion slot on the computer.

A special modem such as Optel's Voice Too and a dedicated telephone line with a standard RJ11C modular jack are used for both voice and data communications. A full-duplex telephone bridge provides for connecting multiple on-line training sites. Special conferencing software, graphic creation and "grab" software are also needed to prepare for and conduct a course.

If you are going to use still-frame color video images in an audiographics session, an image capture board must be installed in the computer and a video monitor must be used to display these images. A speakerphone and unidirectional microphone (with mute capability) are recommended if there are two or more persons at a training site.

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Developing Telecommunication Linkages for Microcomputer-Aided Instruction

Charles R. Blinn, Jan A. Flack, and Peter C. Bates[1]

ABSTRACT

As microcomputer use increases, there is a concomitant increase in the need for timely and efficient microcomputer training and problem solving. While face-to-face education and telephone contacts are most frequently used to provide these services, alternative distance education delivery systems need to be developed as training and travel funds become limited.

The Telecommunications Development Center, the Department of Forest Resources, and the Minnesota Extension Service, University of Minnesota, evaluated two personal computer (PC) microcomputer teletraining systems (audiographic conferencing) to determine the effectiveness of this technology for point-to-point and multipoint distance education. System components at each location included a modem, a standard telephone line, a device for amplifying voices, and appropriate software. A commercial teleconferencing bridge was used to facilitate linking the instructor with two or more trainee locations.

Pilot tests indicated that microcomputer teletraining can greatly reduce training costs without sacrificing training effectiveness. To payback the initial system investment, this technology would be most appropriate where long-term training requirements conducted on a frequent basis to multiple remote sites are identified.

INTRODUCTION

The widespread availability of microcomputers has led to increased applications of this technology in business. The adoption of microcomputers has proceeded at such a rate that many users lack the proper background and training to properly utilize this technology. Continuous advances in both software and hardware systems have further increased the need for effective training of personnel.

There are many private firms and educational institutions capable of providing much of the needed training. However, these training organizations are often centrally located (frequently in larger metropolitan areas), forcing many trainees to travel to training sites. For some firms, these travel expenses may either preclude participation or may limit the number of individuals attending training sessions. Additionally, to maximize the amount of information presented to these trainees, some session planners conduct training sessions longer than trainees' attention span. This may result in reduced training effectiveness because of a reduction in the amount of information assimilated by the trainee.

For those organizations that provide problem solving assistance beyond the initial training, the trainee generally has to telephone the appropriate individual and describe the problem. It may take longer than necessary to solve the problem if the trainee and the problem solver cannot clearly communicate the problem and/or solution to one another.

Individuals who need training and problem solving assistance, as well as those organizations that provide these services, need cost-efficient and effective means of obtaining and providing this information. Teletraining, an integrated system for the delivery and management of training programs through the use of telecommunications (standard telephone lines and other appropriate hardware and software, depending upon the needs) (Parker

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1984, Reilly 1983), may present a means for providing this capability. Audiographic conferencing allows one or more instructors to be connected with trainees located at one or more remote sites (Maher 1986). During a teletraining session, the communications medium allows the instructor and the trainees at each site to share the same questions, answers, and opinions, as well as the same written and visual materials.

Teletraining is generally used in one of three modes: video, audio, or computer (Neumann 1985). These three modes can be combined to fit specific situations. Various microcomputer systems have been developed to link one instructor with one trainee (point-to-point teleconferencing) (Goodman 1987; Stone 1987, 1988). While these systems do not permit simultaneous transmission of both voice and data transfer over one telephone line, a "chat window" may be available so users can communicate by typing messages. One of the main applications of these systems has been by software developers when providing support to clients where voice requirements and total on-line time are minimal (generally less than 15 minutes).

The Telecommunications Development Center (TDC), the Department of Forest Resources, and the Minnesota Extension Service, University of Minnesota, initiated a study in April 1986 to examine the potential of using teletraining via audiographic conferencing to provide microcomputer training to staff and natural resource professionals. The project would determine whether teletraining would provide a more effective allocation of training resources while increasing the responsiveness to training needs. Project objectives included: 1) determining the requirements of the teletraining system, 2) determining the availability of existing systems, 3) conducting pilot tests of appropriate systems, and 4) evaluating the effectiveness and cost-efficiency of the pilot tests.

PROJECT DESCRIPTION

Within the past five years, all Minnesota county extension offices and many public natural resource agencies have obtained IBM or compatible microcomputers. During the first two years of computerization, training needs were generally met through traditional face-to-face classroom instruction in St. Paul, Minnesota, multi-county sessions at regional sites, and/or in the trainee's home office. Problem-solving assistance was provided through telephone conversations or on-site visits. However, as reallocation of training personnel and reductions in travel funds became more commonplace, effective training alternatives needed to be examined.

At the time of project initiation, the idea to conduct microcomputer teletraining preceded the existence of a marketable product that would facilitate this training. Although there were no readily available products that would facilitate microcomputer teletraining, two firms indicated an interest in further developing their products to provide this capability. These two firms were Tori Corporation, Minneapolis, Minnesota, and Optel Communications, New York, New York. Project personnel worked with these two firms to assist them with conceptualizing product development and pilot testing of prototype systems. As the systems tested were still in the development stage, the pilot tests were similar to product beta tests (i.e., tests of system components still undergoing development were performed under actual operating conditions).

DISCUSSION AND RESULTS

System Requirements

Project investigators worked with system designers from Tori and Optel to develop system requirements. These requirements were based upon the investigators' knowledge of clientele and training procedures, and the developers' understanding of the technology and its capabilities.

It was established that the system should allow one or more instructors using IBM or compatible microcomputer hardware to communicate directly with each trainee's compatible hardware (Figure 1). Each computer in the system would require a specialized modem with appropriate software and access to a standard telephone line. Other teleconferencing capabilities, including a commercial bridge, could be used during sessions involving multiple training sites (multipoint teleconferencing). All linked microcomputers would be required to run the same version of the software training package and the system software during every training session.

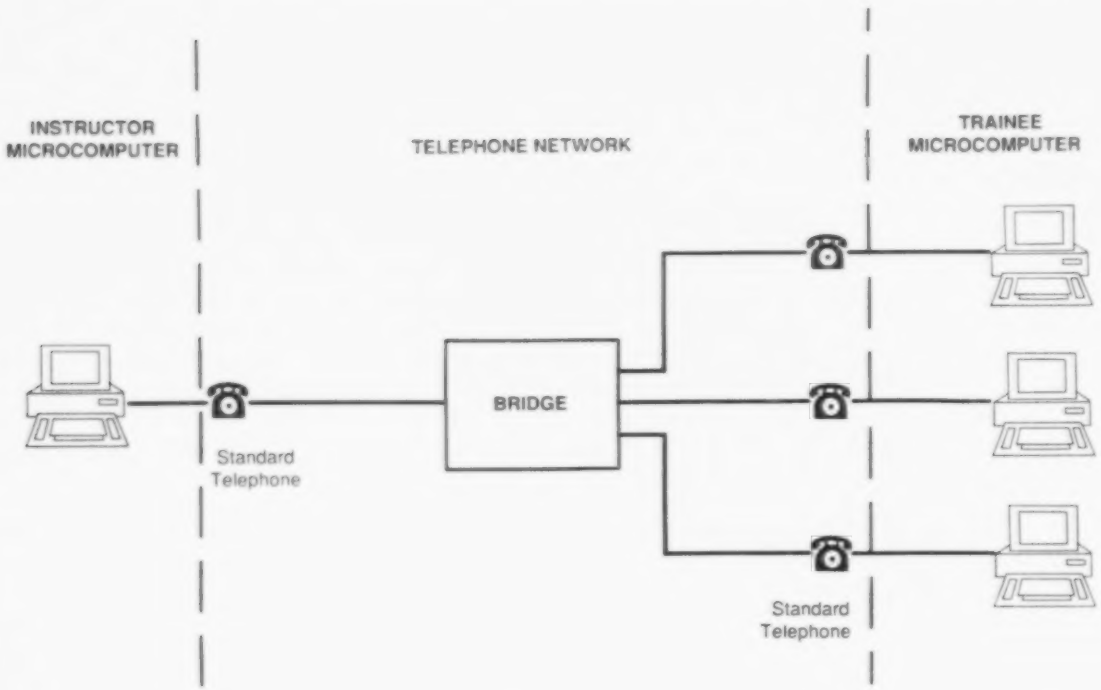
Project investigators recommended several minimum system requirements that would be useful in every training session. These include the ability: 1) to type and broadcast keystrokes on one computer and have them received simultaneously on computers at one or more locations, 2) to incorporate error checking for each data element passed through the system, 3) to support a "master/slave" linkage, 4) to support both voice and data transfer over one standard telephone line, 5) to transfer files between locations, and 6) to provide an instructional feedback utility for the instructor to receive and view the current information displayed on any trainee's computer screen.

1. Broadcast keystrokes

The system must allow the instructor to demonstrate a computer application (i.e., the operating system, a data base manager, a spreadsheet program, etc.) by typing and broadcasting appropriate keystrokes from a centralized or "home" computer, with each keystroke being received on the trainee remote site microcomputer(s). Because miscellaneous keystrokes may cause remote site computers to operate incorrectly, it is critically important that all keystrokes be broadcast and received as sent to ensure computer synchronization within the system. Since trainees could cause their computer to begin operating out of sync by pressing keys at the wrong moment, a keyboard enabling and disabling feature set by the instructor would be useful.

To meet the needs of the dispersed clientele, linkage in both a point-to-point and a multipoint environment must be feasible. Multipoint linkages would be accomplished through a commercially available telephone voice bridge or teleconferencing system. While bridges may accommodate more than 50 sites, training effectiveness may decrease when there are more

Figure 1. Proposed telecommunications system for microcomputer training



than 5-8 trainee locations or for those situations where frequent interaction between participants is required.

2. Error checking

As telephone lines at remote locations may be subject to varying quality, the system must ensure that all broadcast keystrokes are received without error. Two possible ways in which error checking might be implemented include: 1) to broadcast each keystroke multiple times, or 2) to individually poll each linked computer to ensure receipt of correct data. Under the second method, missing data elements would be rebroadcast to individual locations that did not receive the correct data until synchronization was ensured. Regardless of how error checking is implemented, it must be done quickly and efficiently.

3. Master/slave linkages

The master/slave linkage must allow the trainee ("slave") computers to be driven by a single computer ("master") generally operated by the instructor at the home facility. This master/slave linkage must be capable of being toggled on and off during a session to allow trainees to practice from instructional materials. Also, the system must have the capability of passing the master control to any other computer involved in the training session. This allows any location to become the master. This latter utility would be useful when multiple instructors provide training from distant locations.

4. Simultaneous voice and data transfer over one telephone line

As trainee and/or instructor locations may only have access to one telephone line and long distance charges may be incurred during a teletraining session, the system should be able to carry both voice and data over one standard telephone line. Simultaneous broadcast of voice and data would be optimal. A speakerphone or a head set with a built-in microphone connected to each telephone is recommended to amplify voice transmissions and to allow personnel to free their hands from the telephone hand set for taking notes and/or for typing on the keyboard during practice sessions.

5. Transfer files

Simultaneous file transfer between all locations or a subset of the on-line sites must be feasible. These transfers must incorporate error checking. While file transfer is a useful utility, this process was not very fast at the transmission rates tested in the two pilot systems (1200 baud). Therefore, the instructor should minimize the on-line transfer of files, especially those larger than 10K, until system transmission rates exceed 1200 baud.

6. Feedback utility

Each system must allow the instructor to "look over the shoulder" of the trainees through an instructional feedback utility. Through this utility, the instructor can receive the current screen

displayed on any trainee's computer and send screens to specific locations. This allows the instructor to monitor trainees progress and to assist them in solving any problems that may occur as they practice instructional material. This utility would also be useful when providing computer support and problem solving not tied to a training session. System cost, ease of setup, and quality of technical documentation are also important.

In addition to these minimum system requirements, extra system capabilities that might be useful for some specific training applications include the ability to capture screen images for production of a slide show and to use a graphics tablet and pen. Screen images, such as a graph or other information, could be created, captured, stored, and presented in a slide show format. The tablet and pen would be useful for annotating screen information. Some users also might find it beneficial to include a picture phone during the training session so that participants could view each other.

Availability of Existing Systems

As stated earlier, no existing systems were on the market when the project was initiated. While many manufacturers market "Hayes-compatible" modems, these modems are not currently capable of providing many of the system requirements. However, by utilizing "raise carrier" modems and appropriate software and hardware, Tori and Optel were able to provide these capabilities. With each of these modems, there is a noticeable decrease in the strength of the voice communications as additional remote sites and as data communications are added to the line.

Tori Corporation is currently marketing a modem called Interceptor that allows keystrokes to be passed and files to be simultaneously transferred (at 1200 baud) between one or more sites within a master/slave environment. Instructional feedback monitoring is facilitated through its MultiCom utility. While Interceptor does not allow simultaneous voice and data transfer, the capability to toggle back and forth between these two requirements is to be made available in a 300 baud modem. Slide show capability and a graphics tablet and pen are supported by the Tori system. Tori Corporation has successfully tested the passing of keystrokes through Interceptor in a multipoint demonstration with eight sites located across North America. When the pilot tests with the Tori system were conducted, the transmission rate was 1200 baud.

Optel Communications markets a modem called Voice-Too that facilitates simultaneous voice and data transmission (300 or 1200 baud) in both point-to-point and multipoint environments. This system supports a graphics tablet and pen, transfer of screen captured slide show information, still frame video images, and hand drawn annotated information. The other system requirements have been provided to the Voice-Too modem through an application called Joint Runner. Optel indicated its system would operate on raise carrier modems sold by other vendors at transmission rates faster than 1200 baud. Optel may modify its system in the future to provide all requirements, except multipoint capability, for application with Hayes-compatible modems.

System Pilot Tests

Four pilot tests were conducted to evaluate the effectiveness and efficiency of microcomputer teletraining. Two pilot tests were conducted with each of the vendor's systems. In all cases, the instructors were located in St. Paul, and the system hardware and software were mailed to trainees from this location or from the vendors' home offices. Background information concerning each test is shown in Table 1. One individual who received training in the third pilot test was also one of four individuals who took part in the first test. Speakerphones were used to amplify voices in all but the last pilot test when head sets were employed. Tori had a preliminary setup manual that was distributed to all remote sites, but Optel did not yet have documentation available.

Table 1. Background data for the four pilot tests.

Test number	Hardware vender	Trainee location(s)[1]	Number of trainees	Number of telephone lines per location	Hardware setup method[2]	Training material	Session length (min.) Setup	Training
1	Tori	Bemidji, Minn.	4	2	O	Word processing	30	85
2	Tori	Montevideo, Minn. Pipestone, Minn.	4	2	I	DOS	--	130
3	Optel	Bemidji, Minn.	1	1	U	Word processing	0	135
4	Optel	Red Lake, Minn. Naytahwaush, Minn. Cass Lake, Minn. Crandon, Wis. Bowler, Wis.	5	1	O	Database manager Word processing	50	160

[1]The instructor was in St. Paul, Minn. for all pilot tests.

[2]Hardware setup method: O-One or more days ahead of the training session with instructor telephone assistance and time allowed to test the system, I-Immediately before conducting the training session, U-Unassisted setup by trainees.

Individuals who took part in the first three training sessions were being exposed to new software in every case. Although only one individual in the fourth training session was exposed to new software, the session was designed to provide information new to all trainees. Most trainees had some previous experience using computers, except for two participants in the second training session.

During the first two tests, the Tori hardware did not yet have the capability for simultaneous broadcast of voice and data. Separate telephone lines were used in each office. The Tori system was in the early stages of development during the time these tests were conducted, and the University of Minnesota was in the process of changing telephone systems.

In the first pilot test, word processing was taught in a point-to-point mode to four individuals employed by a public forestry agency. Only one of the four trainees was at the computer at any one time. A maximum of two people per station would be ideal. System installation was conducted and tested several days prior to the training session. This preliminary setup included the creation of a separate subdirectory for word processing information and the installation of several files at the linked site. This portion of the setup was accomplished from the home site utilizing the technology, and through the application of pre-designed batch files and Interceptor. A period of about 10 minutes was then provided for trainees to test the system and to become more familiar with the technology.

The disk operating system (DOS) was taught in a multipoint environment to two Minnesota Extension Service county offices during the second pilot test. At each remote location, one individual who was unfamiliar with computer operations was trained. A second individual stood by at each location to provide assistance and to learn more about DOS commands. All trainees were requested to read all training materials before the session to provide background information and to bring all attendees to a common minimum level of knowledge. Telephone linkages were accomplished through the State of Minnesota bridge (Confertech). System installation was accomplished immediately prior to the pilot test. No computer files were installed prior to the training session.

The third and fourth pilot tests were conducted using Optel Communication's Joint Runner application. Both voice and data were integrated over one telephone line, and the state's Confertech bridge was used during both tests. Extensive in-house tests of the Joint Runner application were performed prior to conducting these pilot tests.

Word processing software was taught in a point-to-point mode in the third test. Despite the lack of documentation, an individual at the remote site was able to install the Optel modem, the communications cables (from the modem to the computer and to the telephone), and the speakerphone without requiring any instructor guidance. No practice time was provided before this test.

The final pilot test was designed to evaluate: 1) the performance of the Optel system across a wide geographic area (relative to the three previous tests), and 2) the instructor's ability to conduct a teletraining session with five remote sites. Most of the trainees were located at remote sites where telephone communications were not always dependable. This may have led to some of the communications difficulties encountered during the setup and training sessions. The preliminary setup included the installation of several files using the master/slave capability. While the instructor had been ensured by the computer systems supervisor that all five remote sites were configured exactly the same, this was not the case. System setup and the conduct of this training session were more difficult because of hardware and software differences between remote sites (dissimilar subdirectories where programs were stored, limited access to the one telephone in the office, program defaults preset by the local office, etc.).

Differences in setup methods between the four pilot tests were due to trainee availability for installation, and variation in the ability of local individuals to follow the enclosed vendor's installation instructions when setting up the system. Each training session, including initial setup and a question period at the end of the session, lasted approximately two hours. All telephone charges incurred during each pilot test were paid by the project.

Training materials, curricula, and method of presentation were evaluated and altered prior to each training session to follow recommended guidelines (Appel 1984, Baird 1976, Monson 1978). Discussions and targeted questions designed to facilitate active student participation, repetition, and short learning segments were some of the methods used to enhance the teletraining sessions.

The teletraining also required that the instructors spend additional preparation time as compared to traditional instruction. Instructors had to ensure computer compatibility at all locations, to develop installation batch files, to mail training and evaluation materials as well as system hardware and software ahead of time, and to spend more time structuring the training session to provide interaction between all participants. The additional time requirement was approximately 1-2 hours per training session. For the four pilot tests, the number of remote sites in a training session had little effect on the amount of additional time required to prepare for a training session. As instructors became more proficient in their preparation with each ensuing pilot test, it was felt that slightly less time would be needed in the future once preparation procedures had been mastered.

A cover letter was enclosed with each training packet (educational materials, one or more diskettes containing setup and training files, etc.) that described the concept of telephone-based instruction and the material that was to be covered in the course. Each training location was instructed to obtain an amplified phone set (speakerphone or head set) to allow enhanced voice communications. While head sets were purchased by an external agency for trainee use during the fourth training session, and for future use, speakerphones were readily available at all locations during the other pilot tests.

Prior to conducting the first pilot test, evaluation procedures were established through the assistance of Quality Evaluation & Development, Menomonie, Wisconsin. Factors evaluated in each pilot test included reactions to the technology, the

telecommunications hardware, the training, and overall reactions to the training program. Oral comments provided by the trainees and reactions and comments provided by the instructors were also recorded on paper and evaluated. Instructors had previously provided traditional instruction to most of the trainees in the pilot tests, so direct comparisons could be made between teletraining and face-to-face training.

Training Effectiveness and Efficiency

Training effectiveness -- Hardware difficulties developed during both Tori pilot tests making it impossible to continuously pass computer keystrokes and data through the system. Not all sites were capable of simultaneously receiving keystrokes during the second test when three sites (one instructor and two remote sites) were linked. Several attempts at making new connections through the bridge failed to solve the problem. Tori Corporation later evaluated these failures and determined that some of the problems were attributable to differences in telephone systems. Although Tori had tested its system on the "old" telephone system at the University of Minnesota, they had not performed any tests with the "new" system. As a result of system difficulties, instructors had to deviate from their lesson plan in order to provide meaningful training.

All trainees reported they were very excited with the technology. Trainees from the first two tests indicated that they were disappointed that the Tori system was not fully operational throughout the entire session. These individuals felt that a fully operational system might have further enhanced the training.

During the fourth test, it was difficult for anyone in Minnesota to hear the students at the two Wisconsin sites. The individuals at these two sites were only able to consistently hear the instructor during this test. Also, there were occasional problems passing keystrokes to these two sites (less than 10 occurrences in total). It is not known if this problem was a function of the Optel system, the Confertech bridge, or the local telephone system at those two locations.

After the fourth test, further tests on the Confertech bridge between five computers staffed by project personnel and Optel Communication engineers were unable to duplicate the problem (both voice and data communications worked flawlessly). A new version of the Joint Runner software was tested during these in-house tests. This new version of the software may have solved the problems.

None of the trainees indicated they experienced any problem either installing or disassembling the Tori or Optel systems. This was surprising given the lack of instructions for the Optel system, and that all people who accomplished the installations were novices at this task. Two negative comments were made concerning the Tori documentation. Both comments were passed on to system developers.

The reaction to the concept of teletraining for facilitating microcomputer training was very positive, despite data transmission difficulties. Of the fourteen students trained in the four pilot tests, 10 (71.4 percent) indicated they had learned as much during the training session as if the instructor had provided face-to-face training, two (14.3 percent) indicated they learned more, and two (14.3 percent) indicated they learned less. Similar results have been reported in other studies (Haaland and Newby 1984, Mason 1985, Reilly 1983). Of the two individuals who indicated they had learned less than in face-to-face training, one indicated that seeing the keystrokes displayed on their screen would have been beneficial (This student attended the second training session.), and the other individual indicated that pre-work would have been helpful. This latter individual, from the fourth training session, was not as familiar with computer operations as were the other four trainees. Assigning pre-work to all trainees several days before a training session would assure a common minimum level of knowledge among trainees, thereby maximizing training efficiency.

Interaction between the instructor and the students was reported to be very high, increasing the positive response to the teletraining. It is not known to what extent trainee interest was enhanced due to involvement with a new technology. It is possible that trainees might become less attentive during a longer training session. Therefore, instructors may wish to break a long training session into multiple segments, conducting the course over several days with practice assignments between sessions. A training course organized in this manner might result in greater understanding by the students. This may be a real advantage as compared to face-to-face training where instructional segments are generally longer. In some of those longer courses, the amount of information retained by the trainee is expected to decrease as the session continues.

The fourth training session emphasized the need for the instructor to become more familiar with the configuration of each remote microcomputer before conducting any training. While the instructor had been told that all configurations mirrored each other, this was not the case. Differences in local hardware and software setups became more apparent as the setup and training sessions progressed. To limit this problem, the instructor may wish to load all necessary files into a temporary subdirectory on each trainee's computer, assuming that all trainees have hard disks with available storage space. This installation is best accomplished through development of batch files sent to each site ahead of time. Configuration differences at the remote sites might not have been a problem for computers without hard disks. If possible, only the original unaltered software should be used in a training session.

The two methods used to amplify voices during the pilot tests were speakerphones and head sets. Several positive comments were received from trainees in the fourth session where head sets were employed. It is possible that trainees may feel more comfortable with head sets than with speakerphones. It was not possible to compare audio quality between head sets and speakerphones.

The individual who took part in the first and third training sessions indicated a preference for the Optel system. This reaction was not surprising given that this individual indicated it was helpful to have already taken part in the first pilot test, the system was fully operational when the Optel system was being tested, and there were no other trainees in attendance during the Optel

session.

Approximately half of the trainees reported they experienced some anxiety during the first 10-15 minutes of each training session due to lack of familiarity with the technology and teletraining. However, they felt relaxed and unafraid after this initial period, even when the computers could not be linked to each other in the system. The instructors felt some of this initial anxiety was because some of the trainees were novice computer users.

Given the time savings by not traveling to remote sites, combined with the results from the four pilot tests, the instructors were very enthused after testing the technology. The amount of additional pre-work required for the instructors before conducting each training session was not deemed excessive and helped better prepare the instructors for the technology problems that occurred. While the two-hour training sessions were short in comparison to some educational programs the instructors were already conducting, it was felt that breaking up a long teletraining session into shorter intervals might be appropriate. This might help increase student attentiveness and understanding, especially for those students who might get bored with the lack of visual contact with the instructor.

From an instructional standpoint, the fourth pilot test was not much more difficult to conduct than were the previous three tests. All trainees felt they were active participants in the program. It is not known how successful a training session might be if other remote sites were added. Also, if voice communications become progressively worse as the size of the conference is increased, it might be appropriate to limit the number of remote sites to approximately five.

The instructors felt microcomputer teletraining via audiographic conferencing might make it possible to simultaneously access more trainees at one remote location who are unable to travel to a training site, thereby increasing effectiveness. However, it would not be possible to simultaneously provide training to a large audience dispersed at many locations. For that training need, centralized face-to-face training or multiple teletraining sessions would need to be conducted.

It was believed that experts who normally would not be willing to travel to remote sites might be willing to assist with a teletraining session if they did not have to leave their home office. Also, the system would provide immediate on-line trouble shooting as problems arise.

Despite the problems incurred, all instructors and trainees indicated they would be willing to take part in future teletraining tests and that they would recommend the system to other individuals. Given the potential reduction in travel combined with a possible increase in work performance, and no significant loss in training effectiveness, the instructors were eagerly awaiting further integration of this technology to facilitate their tasks.

Training efficiency -- Additional costs that may be incurred when applying this technology could include the purchase/lease/rent of the communications hardware (communications board and modem) and software, long distance and teleconference or bridge charges, and a speakerphone or a head set. An

Table 2. Estimated cost comparisons of teletraining (Method 1) and instructor travel (Method 2) for the four pilot tests as well as the percent reduction in cost achieved by teletraining.

	Costs: Method 1 (teletraining)					Costs: Method 2 (instructor travel)			
Test number	Communications[1]	Postage/ shipping[2]	Training salary[3,4]	Voice amplifier[5]	Total	Trainer salary[3]	Travel[6]	Total	Cost reduction percent
1	83.61	14.50	68.54	20.00	186.65	199.79	171.25	371.04	49.7
2	63.65	39.00	72.92	30.00	205.57	243.06	176.75	419.81	51.0
3	24.85	18.75	74.38	20.00	137.98	214.38	171.25	385.63	64.2
4	177.55	59.70	96.25	60.00	393.50	637.78	479.00	1116.78	64.8
Total					923.70			2293.26	59.7

[1]Includes long distance fees and bridge costs, where appropriate.

[2]System hardware and software were shipped from St. Paul, Minnesota, or from the vendor's home office, to trainee locations and then returned.

[3]Trainer salary for: Method 1 - conduct of the course and additional preparation time; Method 2 - the conduct of the course and driving time. It was assumed that trainer salary was $35,000/year (including benefits) and that this individual works 2000 hours/year ($17.50/hour).

[4]Includes two hours of additional preparation time to ensure computer compatibility at all locations, to develop installation batch files, to ship system software and hardware, and training and evaluation materials,and to structure the training session to provide interaction between all participants.

[5]A speakerphone or head set assumed to be rented at a cost of $10/site.

[6]Assumed to be reimbursed at the rate of 22.5 cents/mile, $55/day per diem.

organization should also evaluate maintenance, availability of support, the length of time before the equipment becomes obsolete, and the expected life under use when considering the purchase of these teletraining systems. System expected life may be reduced if the system components have to be shipped to each remote site prior to a training or problem solving session.

Reductions in personnel travel time and expenditures occur by allowing the information to travel instead of the instructor and/or the students. Because of reduced personnel travel, more time may be available for reallocation to other tasks.

Actual cost figures and estimates were obtained from the four pilot tests to allow comparisons to traditional training sessions where the instructor traveled to each remote site (Table 2). These cost estimates may be conservative for some organizations. This analysis does not consider the purchase price of this technology as neither vendor was willing to quote a price for its product since the systems were still under development.

In all cases, microcomputer teletraining (Method 1), where system hardware and software were maintained in St. Paul or at the vendors' home offices and mailed to trainee locations, was less expensive than face-to-face delivery (Method 2). In fact, Method 1 showed nearly 50 percent cost savings for each of the four tests. Across the four pilot tests, Method 1 showed an estimated savings of more than $1,350 as compared to face-to-face delivery. Method 1 showed the highest percent cost reduction under the Optel system because only one telephone line was used for voice and data transmission.

While the pilot tests indicated that cost savings could be achieved without sacrificing training effectiveness, it is recommended that individuals evaluate each potential application of this technology before applying it. For an organization considering the purchase of this technology, some cases where traditional face-to-face training or problem solving might still be cost-efficient include:

1. Training or problem solving sessions where both of the following are true: a) there are many students who require assistance, and b) too many teletraining sessions would have to be conducted to effectively meet the need. Each of the four pilot tests trained a few students. It may have been more cost-beneficial to have provided traditional face-to-face training if a larger audience needed training.
2. The organization does not have: a) a demonstrated need for training and/or problem solving over an extended period of time, or b) the potential to rent/lease the equipment to/from another firm. In some instances, it may be more cost-beneficial to employ trainers or problem solvers on a temporary basis.
3. There is no need to provide training or problem solving to personnel at more than one site.
4. System maintenance and/or support for the teletraining hardware and software are deemed to be unacceptable. Also, system life is anticipated to be excessively reduced if system components need to be shipped to remote sites prior to each session.

SUMMARY AND CONCLUSIONS

Microcomputer teletraining may be both an effective and cost-efficient alternative to traditional face-to-face delivery where training is needed on a recurring basis to several remote sites. Pilot tests conducted using this technology indicated that approximately 85 percent of the trainees indicated they learned at least as much as they would have through traditional face-to-face delivery. Estimates of costs indicated that there was at least a 45 percent saving in each of the four pilot tests, as compared to having the instructor travel to each remote site. Pilot test cost estimates did not include system purchase price or any allowance for system maintenance or support.

Instructor innovation is useful to ensure a successful training session should technical problems arise. While problems were incurred with the technology, it is anticipated that system engineers will repair these flaws before final products are marketed. Instructors will need to adjust their training programs to consider any restrictions that will be built into the systems when they are marketed.

While the project did not conduct any pilot tests to assess the effectiveness of the system for meeting problem solving needs, the instructors felt this would be possible. However, the instructor and all remote sites might need to maintain their own system hardware and software for problem solving to be as responsive as possible. This might require the purchase of additional system units, all of which should be justified economically.

Discussions with various educators indicate that there may be further applications of the technology beyond microcomputer training and outreach education. An example application might be during goal-setting sessions where trainees would use a word processor to capture and report their thoughts. Trainee files could then be sent to the instructor for review at the end of the goal-setting session. In a similar manner, the system could also be used to increase the involvement of personnel in the decision-making process, interactively recording and refining appropriate documents.

RECOMMENDATIONS

Recommendations can be grouped into two categories: 1) recommendations for those that may wish to apply the technology discussed in this report, and 2) recommendations for further research. Each of these recommendations are described below.

Recommendations when using the technology

1. Become familiar with guidelines for conducting teleconferences and teletraining sessions. To do this, the instructor(s) should read appropriate materials and/or attend appropriate training sessions and integrate pertinent recommendations.
2. Send out pre-work to participants to bring everyone to a common level of understanding. *Allow sufficient time for trainees to read and absorb this pre-work.*
3. Develop batch files wherever possible to automate the installa-

tion of program and/or system files. Wherever possible, send a copy of the original software to each remote site and then install all software in a separate temporary subdirectory. Installation on a separate subdirectory is most appropriate on those computers that have a hard disk. *Maintain compliance with copyright laws when sending out software.*

4. Limit the number of trainees per remote site to a maximum of two.

5. Obtain speakerphones or head sets for each remote site.

6. Ensure that trainees will not be disturbed by their office environment during the training session.

7. Be aware that the strength of voice communications degrades as additional sites are added to a conference and as data transmission capabilities are enabled. Limit the number of sites so that each location can hear all other participants.

8. If a training session is to last more than two or three hours, consider breaking the program into shorter learning segments with assignments given between each session.

9. Ensure that all participants are using the same version of software. Also make sure that remote sites have not made any unexpected pre-assignments in program operation or program defaults.

10. Do not assume that teletraining will be the most efficient or effective method for providing microcomputer training and/or problem solving in all instances. Evaluate each application before making a final decision. For those organizations that do not have a frequent need to utilize this technology, there may not an adequate reason to consider adopting it and purchasing the necessary hardware and software.

11. Limit on-line transmission of files between sites to those files that are 10K or smaller. This recommended maximum file size would increase as modem transmission rates increased beyond 1200 baud.

Recommendations for further research

1. Further evaluate the Tori system. Although developers of this system indicated it was ready for review, project investigators were unable to gain experience with the final system.

2. Evaluate the Optel system, once Optel has provided system capabilities in a point-to-point mode through a Hayes-compatible modem.

3. Conduct and evaluate other teletraining programs which vary in terms of length, subject matter, or system capabilities tested. Examination of different system capabilities may include the testing and evaluation of training sessions that utilizes graphics, a slide show, and/or the tablet and pen.

4. Test available systems on bridges other than the Confertech bridge.

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